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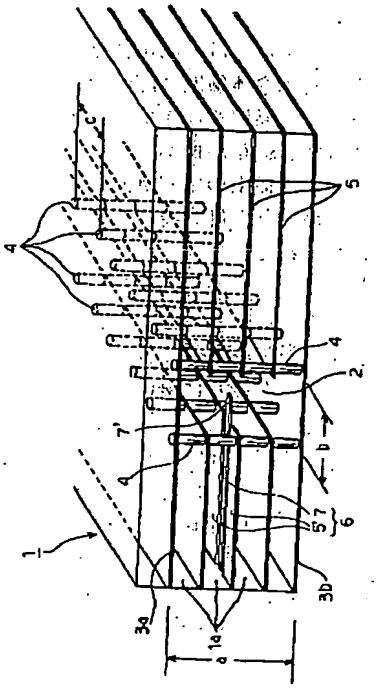
(54)【発明の名称】誘電体導波管線路の結合構造

(57)【要約】
【課題】誘電体の内部に疑似的な導波管を形成した誘電体導波管線路を他の伝送線路と組み合わせて用いることができなかった。
【解決手段】誘電体基板1の少なくとも一部を挟んで対向する一対の主導体層3a，3bと、該一対の主導体層3a，3b間を電気的に接続し、電気信号の伝達方向に遮断波長の1／2以下の間隔で配設された二列のバイアホール4群とを具備し、前記主導体層3a，3b及びバイアホール4群で囲まれる導波管領域によって電気信号を伝達する誘電体導波管線路2と、他の伝送線路6とを結合させるための構造であって、前記誘電体導波管線路2のバイアホール4群で形成された側面もしくは端面を介して該誘電体導波管線路2の内部に他の伝送線路6の線路導体7の一端7'を挿入する。



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【特許請求の範囲】

【請求項１】誘電体基板の少なくとも一部を挟んで対向する一対の主導体層と、該一対の主導体層間を電気的に接続し、電気信号の伝達方向に遮断波長の１／２以下の間隔で配設された二列のバイアホール群とを具備し、前記主導体層及びバイアホール群で囲まれる導波管領域によって電気信号を伝達する誘電体導波管線路と、他の伝送線路とを結合させるための構造であって、前記誘電体導波管線路のバイアホール群で形成された側面もしくは端面を介して該誘電体導波管線路の内部に他の伝送線路の線路導体の一端を挿入してなることを特徴とする積層型導波管線路の結合構造。

【請求項２】前記他の伝送線路がコプレーナ線路、もしくはストリップ線路であることを特徴とする請求項１に記載の誘電体導波管線路の結合構造。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、マイクロ波やミリ波等の高周波の電気信号を伝達するための誘電体導波管線路と他の伝送線路との結合構造に関するものである。

【０００２】

【従来技術及びその課題】従来より、配線基板や高周波パッケージ等の内部に構成される高周波信号用（周波数が１ＧＨｚ以上）の伝送線路として、ストリップ線路やマイクロストリップ線路，コプレーナ線路等が知られている。これらの伝送線路は、複数の誘電体層上に線路となる導体を印刷してこれらを積層するといった積層化技術によって比較的簡単に形成することができ、マイクロ波領域の周波数をもった電気信号の伝送に優れた特性を有していることから、高周波信号用の伝送線路として幅広く用いられている。

【０００３】また最近では、誘電体基板を挟む一対の主導体層と、これら主導体層間に配設される二列のバイアホール群とによって疑似的な矩形導波管を形成するようにした誘電体導波管線路が提案されており（特開平6-53711 号公報参照），従来の矩形導波管と同等の優れた伝送特性と高い生産性とを併せ持つた新しいタイプの伝送線路として注目されている。

【０００４】そして、このような種々の伝送線路は、その伝送特性や用途等に応じて適宜使い分けられており、そのため、配線基板等の内部に種類の異なる伝送線路を複数形成してこれらを相互に接続させる技術が要求されている。

【０００５】ところが、種類の異なる伝送線路同士を相互に接続させる場合、例えば、ストリップ線路とマイクロストリップ線路であれば両者の端部同士を電磁結合させる等して比較的簡単に接続することができるものの、上述のような誘電体導波管線路と他の伝送線路との結合構造についてはこれまで具体的な検討がなされておらず、誘電体導波管線路と他の伝送線路とを組み合わせて

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用いることはできなかった。

【０００６】

【課題を解決するための手段】そこで発明者らは、誘電体導波管線路と他の伝送線路との結合構造について検討を重ねた結果、誘電体導波管線路の側面もしくは端面を介して他の伝送線路の一部を挿入させ、これを電磁気的に結合させることで直接、接続できることを見出した。

【０００７】即ち、本発明の誘電体導波管線路の結合構造は、誘電体基板の少なくとも一部を挟んで対向する一対の主導体層と、該一対の主導体層間を電気的に接続し、電気信号の伝達方向に遮断波長の１／２以下の間隔で配設された二列のバイアホール群とを具備し、前記主導体層及びバイアホール群で囲まれる導波管領域によって電気信号を伝達する誘電体導波管線路と、他の伝送線路とを結合させるための構造であって、前記誘電体導波管線路のバイアホール群で形成された側面もしくは端面を介して該誘電体導波管線路の内部に他の伝送線路の線路導体の一端を挿入してなることを特徴とするものである。

【０００８】また本発明の積層型導波管線路の結合構造は、前記他の伝送線路がコプレーナ線路、もしくはストリップ線路であることを特徴とするものである。

【０００９】

【発明の実施の形態】以下、本発明を添付図面に基づいて詳細に説明する。図１は本発明の誘電体導波管線路の結合構造に係る一形態を示す概略斜視図であり、１は誘電体基板、２は誘電体導波管線路、３ａ，３ｂは一対の主導体層、４はバイアホール、６は他の伝送線路としてのコプレーナ線路、７はコプレーナ線路６の線路導体である。

【００１０】前記誘電体基板１は例えばアルミナセラミックスやガラスセラミックス，窒化アルミニウムセラミックス等の誘電体材料から成り、例えばアルミナセラミックスから成る場合、アルミナ、シリカ、マグネシア等のセラミックス原料粉末に適当な有機溶剤、溶媒を添加混合して泥漿状に成すとともにこれを従来周知のドクターブレード法やカレンダーロール法等を採用してシート状となすことによって複数枚のセラミックグリーンシートを得、しかる後、前記セラミックグリーンシートの各々に適当な打ち抜き加工を施すとともにこれらを上下に積層し、高温（約１６００℃）で焼成することによって製作される。

【００１１】また前記誘電体基板１の内部には誘電体導波管線路２とコプレーナ線路６とがそれぞれ配設されており、この２つの伝送線路は誘電体基板１内で相互に結合されている。前記誘電体導波管線路２は、誘電体基板１の少なくとも一部、例えば誘電体基板１を形成する５層の誘電体層１ａのうち、下の４層を挟んで対向する一対の主導体層３ａ，３ｂと、該一対の主導体層３ａ，３ｂ間を電気的に接続し、電気信号の伝達方向に遮断波長

（λｃ）の１／２以下の間隔ｃで配設された二列のバイアホール群（バイアホール４の径：φ５０～３００μｍ）と、前記一対の主導体層３ａ，３ｂ間に各バイアホール４と接続した状態で配置された３層の副導体層５とで形成されている。

【００１２】このような誘電体導波管線路２は一対の主導体層３ａ，３ｂ間に形成されている２つのバイアホール群が電気信号の伝達方向に遮断波長（λｃ）の１／２以下の間隔ｃで配列しており、電気信号の伝達方向に対し垂直な方向に電気的な壁を形成していることから、電磁波を線路の形成方向にのみ良好に伝播させることができる。よって、一対の主導体層３ａ，３ｂと二列のバイアホール群とで囲まれる領域をａ×ｂ（ａ：一対の主導体層３ａ，３ｂ間の距離、ｂ：二列のバイアホール群間の距離）の擬似的な矩形導波管として作用させることができ、マイクロ波やミリ波等の高周波の電気信号を伝達するのに適した伝送線路として用いることができる。例えば、誘電体導波管線路２を伝播する電磁波のモードがＴＥ１０モードである場合、一対の主導体層３ａ，３ｂ間の距離ａを電気信号の中心波長の１／２よりもやや大きく、また二列のバイアホール群間の距離ｂをａ／２程度に設定し、一対の主導体層３ａ，３ｂを形成した面が電界と平行なＥ面になし、またバイアホール４や副導体層５で囲まれた面が磁界と平行なＨ面になす。

【００１３】ここで、前記バイアホール４の配列ピッチｃを遮断波長（λｃ）の１／２以下になすのは、配列ピッチｃが遮断波長（λｃ）の１／２よりも大きくなると、誘電体導波管線路２に電磁波を供給する際、隣接するバイアホール４間より電磁波が漏れ、電気信号が誘電体導波管線路２に沿って良好に伝播しなくなるからであり、従ってバイアホール４の配列ピッチｃは遮断波長（λｃ）の１／２以下に設定する必要がある。

【００１４】尚、前記副導体層５は、誘電体導波管線路２の側壁をより細かな格子状になして電磁波の遮断効果を向上させるためのものであり、誘電体導波管線路２を構成するのに不可欠な構成要素ではない。

【００１５】一方、前記誘電体基板１の内部に誘電体導波管線路２と共に配設されているコプレーナ線路６は、帯状の線路導体７と、前記副導体層５の一部を利用して線路導体７の両側に配される接地導体５とで構成されており、電気信号を前記線路導体７を介して伝播させるようになっている。

【００１６】このようなコプレーナ線路６は、誘電体基板１を構成する誘電体層１ａの一表面上に形成されており、例えば、特性インピーダンスを５０Ωとなすように、線路導体７の導体幅を５０～５００μｍに、また線路導体７と接地導体との間の距離を５０～５００μｍに設定する。

【００１７】かかるコプレーナ線路６や前述の誘電体導波管線路２を構成する一対の主導体層３ａ，３ｂ、バイアホール４、副導体層５及び線路導体７は、誘電体基板１がアルミナセラミックスからなる場合、タングステンやモリブデン等の高融点金属材料により形成され、誘電体基板１を製作する際に誘電体基板１の内部に同時に配設される。即ち、誘電体基板１となる複数のセラミックグリーンシートの表面に、タングステン，モリブデン等の金属粉末を含む導電ペーストを従来周知の厚膜印刷法等を採用することによって５～２５μｍの厚みをもって所定パターンに印刷・塗布するとともに、セラミックグリーンシートに予め開けておいた穴内に導電ペーストを埋め込み、セラミックグリーンシートと同時に焼成することによって誘電体基板１の内部に誘電体導波管線路２及びコプレーナ線路６が形成される。

【００１８】そして、このような誘電体導波管線路２とコプレーナ線路６は、図２，図３に示すように、コプレーナ線路６の線路導体７の一端（以下、スタブという）を誘電体導波管線路２のバイアホール群で形成された側面を介して誘電体導波管線路２の内部に挿入させることにより結合がなされている。

【００１９】かかる結合構造によれば、コプレーナ線路６を伝播してきた電気信号は、線路導体７のスタブ７’を励振させ、スタブ７’を中心とした同心円状の磁界を発生する。そこで前述した誘電体導波管線路２における二列のバイアホール群間の距離ｂをａ／２に設定すると、伝播するＴＥ１０モードと結合し、誘電体導波管線路２とコプレーナ線路６との接続が良好に行われることとなる。

【００２０】尚、前記スタブ７’の長さｄを、伝播させる電気信号の中心波長の１／４に設定すると、スタブ７’が１／４波長のモノポールアンテナと同様の作用をなすので中心波長の電気信号をより効率的に誘電体導波管線路２内に放射させることができる。ただし、実際には図２の右側の接地導体に対してキャパシタンスが、下側の接地導体に対してインダクタンスが発生するので、その分を考慮してスタブ７’の長さｄを微調整する必要があり、このため、スタブ７’の長さｄはａ／４～ａ／３に設定するのが好ましい。

【００２１】また誘電体導波管線路２の端面とスタブ７’の中心との間の距離ｅを、伝播させる電気信号の管内波長の１／４に設定すると、端面で反射されて逆位相となった電磁波は反射されずに進んだ電磁波と同位相で加わるので良好な特性が得られるようになる。ただし、実際には図２の右側の接地導体に対してキャパシタンスが、下側の接地導体に対してインダクタンスが発生するので、その分を考慮して誘電体導波管線路２の端面とスタブ７’の中心との間の距離ｅを微調整する必要があり、このため、前記距離ｅはａ／４～ａ／３に設定するのが好ましい。

【００２２】尚、本発明は上述した形態に限定されるものではなく、本発明の要旨を逸脱しない範囲において種

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々の変更、改良等が可能であり、例えば上述の形態では他の伝送線路としてコプレーナ線路を用いたが、これに代えて、図４のように、帯状の線路導体８と副導体層５’の一部とで構成されるストリップ線路６’を用いても良い。この場合、ストリップ線路６’を伝播してきた電磁波はスタブ８’を励振させて同心円状の磁界を発生するため、これを誘電体導波管線路２を伝播するモードと結合させることにより伝送線路同士の結合を良好に行うことができる。また上述の形態では、誘電体導波管線路２内に挿入されるコプレーナ線路６の線路導体７のスタブ７’を線路導体７の他の部分と略等しい幅になしたが、これに代えて、図５に示すように、誘電体導波管線路内に挿入されるコプレーナ線路等の他の伝送線路の線路導体９のスタブ９’を線路導体９の他の部分よりも幅広になしておけば、コプレーナ線路と誘電体導波管線路との特性インピーダンスの不一致を有効に緩和して伝送特性を向上させることができる。従って誘電体導波管線路内に挿入される他の伝送線路の線路導体９のスタブ９’を線路導体９の他の部分よりも幅広になしておくことが好ましい。

【００２３】更に上述の形態では、コプレーナ線路６の線路導体７のスタブ７’をバイアホール群で形成された誘電体導波管線路２の側面を介して誘電体導波管線路２の内部に挿入させるようにしたが、これに代えて、図６に示すように、コプレーナ線路等の他の伝送線路の線路導体１０のスタブ１０’を誘電体導波管線路２の端面を介して誘電体導波管線路２の内部に挿入させるようにしても構わない。この場合、ＴＥ１１モードの電磁波と結

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合させることによって電磁界との結合が良好に行われる。

【００２４】

【発明の効果】本発明によれば、誘電体導波管線路と他の伝送線路とを簡単かつ良好に接続することができ、一個の配線基板等の内部で誘電体導波管線路を他の伝送線路と組み合わせて用いることが可能になる。

【図面の簡単な説明】

【図１】本発明の誘電体導波管線路の結合構造の一形態を示す概略斜視図である。

【図２】他の伝送線路が設けられている誘電体層の一主面を示す平面図である。

【図３】図２のＸ－Ｘ線断面図である。

【図４】本発明の誘電体導波管線路の結合構造の他の形態を示す概略斜視図である。

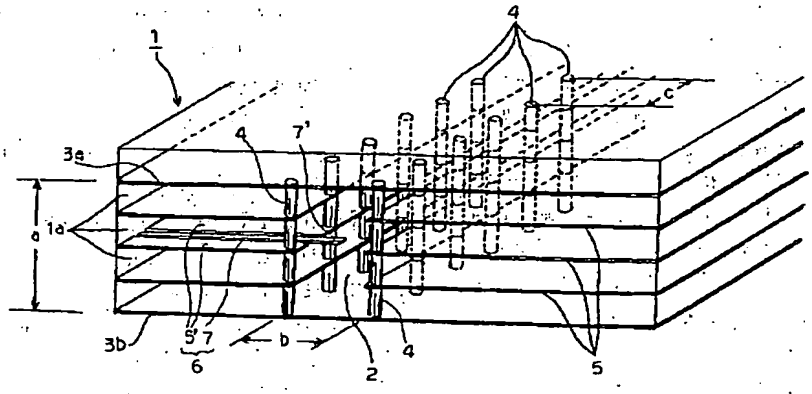
【図５】本発明の誘電体導波管線路の結合構造の他の形態を示す平面図である。

【図６】本発明の誘電体導波管線路の結合構造の他の形態を示す平面図である。

【符号の説明】

１・・・・・誘電体基板
２・・・・・誘電体導波管線路
3a, 3b・・・・・一対の主導体層
４・・・・・・・バイアホール
5, 5’・・・・・副導体層
6, 6’・・・・・他の伝送線路
7, 8, 9, 10・・・線路導体
7’, 8’, 9’, 10’・・線路導体の一端

【図１】



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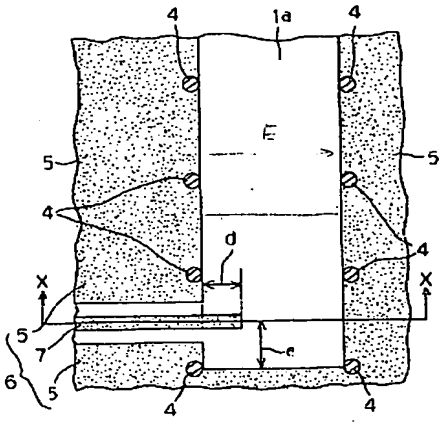
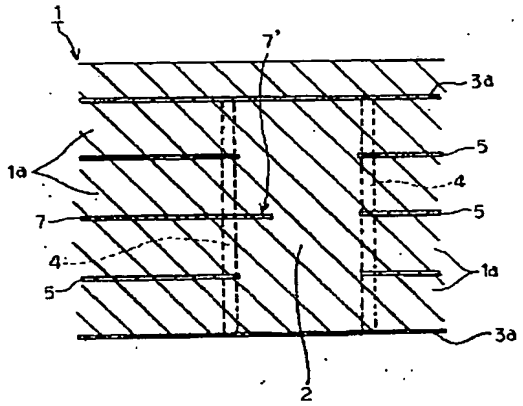

4
1a
4
5
5
4
4
d
X
X
5
7
e
6
5
4
4

【図３】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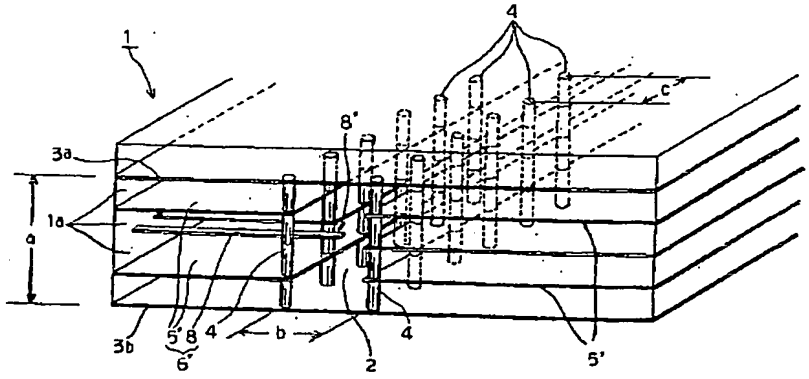
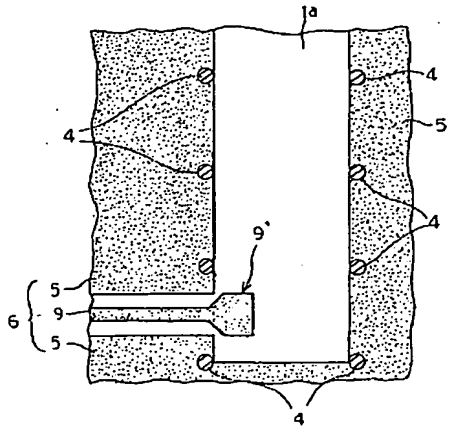
7'
3a
5
1a
4
7
5
4
5
1a
3a
2

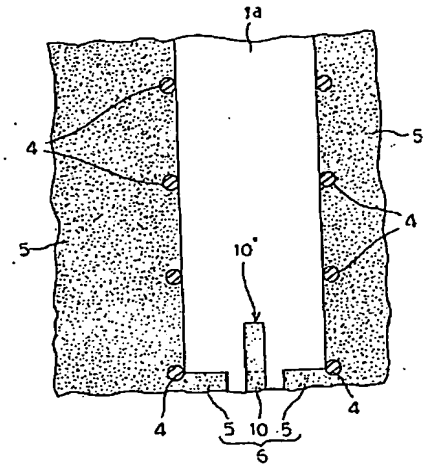
【図４】


4
1
c
8'
3a
a
1a
3b
5'
8
6'
4
b
2
4
5'

【図５】


1a
4
4
5
4
9'
5
6
9
5
4

【図６】


1a
4
5
5
4
10'
4
4
5
10
5
6

Bibliography

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3/00
3/12
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[Translation done.]

* NOTICES *

Epitome

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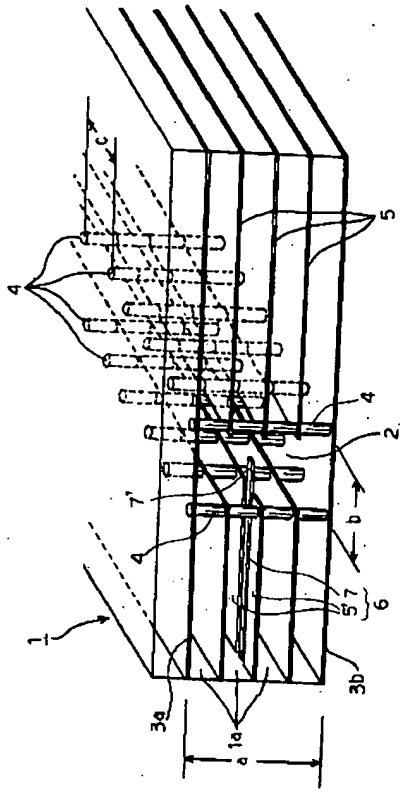
(57) [Abstract]
[Technical problem] The dielectric-waveguide track in which the false waveguide was formed was not able to be used for the interior of a dielectric combining other transmission lines.
[Means for Solution] The initiative body whorls 3a and 3b of the pair which counters on both sides of some dielectric substrates [at least] 1, Connect electrically between initiative body whorl 3a of this pair, and 3b, and Bahia hall 4 group of two trains arranged in the transfer direction of an electrical signal or less [of cutoff wave length] at intervals of 1/2 is provided. The dielectric-waveguide track 2 which transmits an electrical signal by the waveguide field surrounded by said initiative body whorls 3a and 3b and Bahia hall 4 group, It is the structure for combining other transmission lines 6, and end 7' of the line conductor 7 of other transmission lines 6 is inserted in the interior of this dielectric-waveguide track 2 through the side face or end face formed by Bahia hall 4 group of said dielectric-waveguide track 2.

[Translation done.]



[Translation done.]

* NOTICES *

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damages caused by the use of this translation.
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Between the initiative body whorl of the pair which counters on both sides of some dielectric substrates [at least], and the initiative body whorl of this pair is connected electrically. The dielectric-waveguide track which transmits an electrical signal by the waveguide field which possesses the Bahia hall group of two trains

arranged in the transfer direction of an electrical signal or less [of cutoff wave length] at intervals of 1/2, and is surrounded by said initiative body whorl and the Bahia hall group, Joint structure of the laminating mold waveguide track characterized by coming to insert the end of the line conductor of other transmission lines in the interior of this dielectric-waveguide track through the side face or end face which is the structure for combining other transmission lines, and was formed by the Bahia hall group of said dielectric-waveguide track.
[Claim 2] Joint structure of the dielectric-waveguide track according to claim 1 characterized by the transmission line besides the above being a KOPURENA track or the strip line.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the joint structure of the dielectric-waveguide track for transmitting the electrical signal of RFs, such as microwave and a millimeter wave, and other transmission lines.
[0002]
[Description of the Prior Art] Conventionally, the strip line, a microstrip line, a KOPURENA track, etc. are known as the transmission line for high frequency signals (a frequency is 1GHz or more) constituted by the interior, such as a wiring substrate and a high frequency package. On two or more dielectric layers, these transmission lines can print the conductor used as a track, can be formed comparatively easily with the lamination technique of carrying out the laminating of these, and since it has the property excellent in

transmission of an electrical signal with the frequency of a microwave range, they are broadly used as the transmission line for RF signals.
[0003] Moreover, recently, the dielectric-waveguide track in which false rectangular waveguide was formed is proposed by the initiative body whorl of the pair whose dielectric substrate is pinched, and the Bahia hall group of two trains arranged between these initiative body whorls (refer to JP,6-53711,A), and it is observed as the transmission line having the outstanding transmission characteristic equivalent to the conventional rectangular waveguide, and high productivity new type.
[0004] And the technique of forming two or more transmission lines where such the various transmission lines are suitably used properly according to the transmission characteristic, application, etc., therefore classes differ in the interior, such as a wiring substrate, and connecting these mutually is demanded.
[0005] However, when the transmission lines from which a class differs were connected mutually, an examination concrete about the joint structure of the above dielectric-waveguide tracks of what can carry out carrying out the electromagnetic coupling of both edges etc., and can be connected comparatively easily if it is the strip line and a microstrip line, and other transmission lines until now was not made, and it was not able to use combining a dielectric-waveguide track and other transmission lines.
[0006]
[Means for Solving the Problem] Then, artificers found out that it was connectable directly by making a part of other transmission lines insert through the side face or end face of a dielectric-waveguide track, and combining this in electromagnetism as a result of repeating examination about the joint structure of a dielectric-waveguide track and other transmission lines.
[0007] Namely, the joint structure of the dielectric-waveguide track of this invention Between the initiative body whorl of the pair which counters on both sides of some dielectric substrates [at least], and the initiative body whorl of this pair is connected electrically. The dielectric-waveguide track which transmits an electrical signal by the waveguide field which possesses the Bahia hall group of two trains arranged in the transfer direction of an electrical signal or less [of cutoff wave length] at intervals of 1/2, and is surrounded by said initiative body whorl and the Bahia hall group, It is the structure for combining other transmission lines, and is characterized by coming to insert the end of the line conductor of other transmission lines in the interior of this dielectric-waveguide track through the side face or end

face formed by the Bahia hall group of said dielectric-waveguide track.
[0008] Moreover, joint structure of the laminating mold waveguide track of this invention is characterized by the transmission line besides the above being a KOPURENA track or the strip line.
[0009]
[Embodiment of the Invention] Hereafter, this invention is explained to a detail based on an accompanying drawing. Drawing 1 is the outline perspective view showing one gestalt concerning the joint structure of the dielectric-waveguide track of this invention, and, for 1, as for a dielectric-waveguide track, and 3a and 3b, a dielectric substrate and 2 are [the initiative body whorl of a pair, the KOPURENA track as the transmission line of others / 4 / 6 / the Bahia hall and /, and 7] the line conductors of the KOPURENA track 6.
[0010] Said dielectric substrate 1 consists of dielectric materials, such as alumina ceramics, and crystallized glass, alumimium nitride ceramics. When it consists of alumina ceramics, for example, the suitable organic solvent for ceramic raw material powder, such as an alumina, a silica, and a magnesia, The ceramic green sheet of two or more sheets is obtained by adopting a well-known doctor blade method, the well-known calendering roll method, etc. conventionally, and making this with the shape of a sheet, while carrying out addition mixing of the solvent and accomplishing in the shape of slurry. While performing suitable punching processing for each of said ceramic green sheet after an appropriate time, the laminating of these is carried out up and down, and it is manufactured by calcinating at an elevated temperature (about 1600 degrees C).
[0011] Moreover, the dielectric-waveguide track 2 and the KOPURENA track 6 are arranged in the interior of said dielectric substrate 1, respectively, and these two transmission lines are mutually combined within the dielectric substrate 1. Said dielectric-waveguide track 2 The initiative body whorls 3a and 3b of the pair of the dielectric substrate 1 which counters on both sides of four lower layers in part among dielectric layer of five layers 1a which forms the dielectric substrate 1 at least, The Bahia hall group of two trains which connected electrically between initiative body whorl 3a of this pair, and 3b, and were arranged in the transfer direction of an electrical signal or less [of cutoff wave length (lambdac)] at intervals of [c] 1/2 (the path of the Bahia hall 4: phi50-300micrometer), It is formed between initiative body whorl 3a of said pair, and 3b by the subconductor layer 5 of three layers arranged in the condition of having connected with each Bahia hall 4.

[0012] Since two Bahia hall groups currently formed between initiative body whorl 3a of a pair and 3b have arranged in the transfer direction of an electrical signal or less [of cutoff wave length (lambdac)] at intervals of [c] 1/2 and form the electric wall in the perpendicular direction to the transfer direction of an electrical signal, such a dielectric-waveguide track 2 can make an electromagnetic wave spread only in the formation direction of a track to fitness. Therefore, the field surrounded by the initiative body whorls 3a and 3b of a pair and the Bahia hall group of two trains can be made to be able to act as false rectangular waveguide of axb (a: distance between initiative body whorl 3a of a pair, and 3b, distance of b:2 train Bahia hall between groups), and it can use as the transmission line suitable for transmitting the electrical signal of RFs, such as microwave and a millimeter wave. For example, when the mode of the electromagnetic wave which spreads the dielectric-waveguide track 2 is the TE10 mode, Are a little larger than one half of the main wavelength of an electrical signal in the distance a between initiative body whorl 3a of a pair, and 3b. Moreover, the distance b of two trains Bahia hall between groups is set about to a/2, and it makes to an H plane with the field parallel to a field where the field in which the initiative body whorls 3a and 3b of a pair were formed was surrounded by the Eth page parallel to electric field by nothing, and the Bahia hall 4 and the subconductor layer 5.
[0013] Making array-pitch c of said Bahia hall 4 or less [of cutoff wave length (lambdac)] to 1/2 here If array-pitch c becomes larger than one half of cutoff wave length (lambdac), when an electromagnetic wave will be supplied to the dielectric-waveguide track 2, It is because an electromagnetic wave meets leakage, an electrical signal meets the dielectric-waveguide track 2 and it stops spreading good from between the adjoining Bahia-hall 4, therefore it is necessary to set array-pitch c of the Bahia hall 4 or less [of cutoff wave length (lambdac)] to 1/2.
[0014] In addition, said subconductor layer 5 is for making the side attachment wall of the dielectric-waveguide track 2 to the shape of a finer grid, and raising the screening effect of an electromagnetic wave, and is not a component indispensable to constitute the dielectric-waveguide track 2.
[0015] the touch-down to which the KOPURENA track 6 currently arranged in the interior of said dielectric substrate 1 with the dielectric-waveguide track 2 is allotted to the both sides of a line conductor 7 on the other hand using the band-like line conductor 7 and said a part of subconductor layer 5 -- a conductor -- it consists of 5' and an electrical signal is made to spread through said line conductor 7

[0016] such a KOPURENA track 6 is formed on the 1 front face of dielectric layer 1a which constitutes the dielectric substrate 1, for example, makes a characteristic impedance with 50 ohms -- as -- the conductor width of a line conductor 7 -- 50-500 micrometers -- moreover, a line conductor 7 and touch-down -- the distance between conductors is set as 50-500 micrometers.

[0017] When the dielectric substrate 1 consists of alumina ceramics, the initiative body whorls 3a and 3b, the Bahia hall 4, the subconductor layer 5, and line conductor 7 of the pair which constitutes this KOPURENA track 6 and above-mentioned dielectric-waveguide track 2 are formed with refractory metal ingredients, such as a tungsten and molybdenum, and in case they manufacture the dielectric substrate 1, they are arranged in the interior of the dielectric substrate 1 by coincidence. On namely, the front face of two or more ceramic green sheets used as the dielectric substrate 1 While having the thickness of 5-25 micrometers and printing and applying at a predetermined pattern by adopting the conductive paste containing metal powder, such as a tungsten and molybdenum, for well-known thick film printing etc. conventionally Conductive paste is embedded in the hole beforehand made in the ceramic green sheet, and the dielectric-waveguide track 2 and the KOPURENA track 6 are formed in the interior of the dielectric substrate 1 by calcinating to a ceramic green sheet and coincidence.

[0018] And association is made when such the dielectric-waveguide track 2 and the KOPURENA track 6 make the end (henceforth a stub) of the line conductor 7 of the KOPURENA track 6 insert in the interior of the dielectric-waveguide track 2 through the side face formed by the Bahia hall group of the dielectric-waveguide track 2 as shown in drawing 2 and drawing 3 .

[0019] According to this joint structure, the electrical signal which has spread the KOPURENA track 6 excites stub 7' of a line conductor 7, and generates the field of the shape of a concentric circle centering on stub 7'. Then, when the distance b of two trains in the dielectric-waveguide track 2 mentioned above Bahia hall between groups is set as a/2, it will combine with the TE10 mode to spread and connection between the dielectric-waveguide track 2 and the KOPURENA track 6 will be made good.

[0020] In addition, if die-length d of said stub 7' is set as one fourth of the main wavelength of the electrical signal made to spread, since stub 7' will make the same operation as the monopole antenna of quarter-wave length, the electrical signal of main wavelength can be made to emit in the dielectric-waveguide track 2 more efficiently. however --

actual -- the touch-down on the right-hand side of drawing 2 -- a conductor -- receiving -- capacitance -- lower touch-down -- since an inductance occurs to a conductor, it is necessary to tune die-length d of stub 7' finely in consideration of that part, and, as for die-length d of stub 7', for this reason, it is desirable to set it as a / 4 - a/3.
[0021] Moreover, if it sets as one fourth of the guide wave lengths of the electrical signal which makes the distance e between the end face of the dielectric-waveguide track 2, and the core of stub 7' spread, since the electromagnetic wave which was reflected by the end face and became an opposite phase is in phase and is added with the electromagnetic wave which progressed without being reflected, a good property will come to be acquired. however -- actual -- the touch-down on the right-hand side of drawing 2 -- a conductor -- receiving -- capacitance -- lower touch-down -- since an inductance occurs to a conductor, it is necessary to tune the distance e between the end face of the dielectric-waveguide track 2, and the core of stub 7' finely in consideration of that part, and, as for said distance e, for this reason, it is desirable to set it as a / 4 - a/3.
[0022] in addition -- this invention -- having mentioned above -- a gestalt -- limiting -- having -- a thing -- it is not -- this invention -- a summary -- not deviating -- the range -- setting -- versatility -- modification -- amelioration -- etc. -- possible -- for example, -- a **** -- a gestalt -- **** -- others -- the transmission line -- ****** -- KOPURENA -- a track -- having used -- although -- this -- replacing with -- drawing 4 -- like -- band-like -- a line conductor -- eight -- secondary -- a conductor layer -- five -- ' -- a part -- constituting -- having -- the strip line -- six -- ' -- you may use . In this case, since the electromagnetic wave which has spread strip-line 6' excites stub 8' and generates a concentric circle-like field, it can combine the transmission lines good by combining this with the mode which spreads the dielectric-waveguide track 2. moreover, stub 7' of the line conductor 7 of the KOPURENA track 6 inserted into the dielectric-waveguide track 2 with an above-mentioned gestalt -- other parts of a line conductor 7, and abbreviation, although made to equal width of face If stub 9' of the line conductor 9 of other transmission lines, such as a KOPURENA track inserted into a dielectric-waveguide track, is made more broadly than other parts of a line conductor 9 as it replaces with this and is shown in drawing 5 The inequality of the characteristic impedance of a KOPURENA track and a dielectric-waveguide track can be eased effectively, and a transmission characteristic can be raised. Therefore, it is desirable to make more broadly than other parts of a

line conductor 9 stub 9' of the line conductor 9 of other transmission lines inserted into a dielectric-waveguide track.
[0023] furthermore -- a **** -- a gestalt -- **** -- KOPURENA -- a track -- six -- a line conductor -- seven -- a stub -- seven -- ' -- Bahia -- a hole -- a group -- forming -- having had -- a dielectric waveguide -- a track -- two -- a side face -- minding -- a dielectric waveguide -- a track -- two -- the interior -- inserting -- making -- having made -- although -- this -- replacing with -- drawing 6 -- being shown -- as -- KOPURENA -- a track -- etc. -- others -- the transmission line -- a line conductor -- ten -- a stub -- ten -- ' -- a dielectric waveguide -- a track -- two -- an end face -- minding -- a dielectric waveguide -- a track -- two -- the interior -- inserting -- making -- you may make . In this case, association with electromagnetic field is performed good by making it combine with the electromagnetic wave in the TE11 mode.
[0024]
[Effect of the Invention] According to this invention, a dielectric-waveguide track and other transmission lines can be connected simply and good, and it becomes possible to use a dielectric-waveguide track combining other transmission lines in the interior, such as a wiring substrate of a piece.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline perspective view showing one gestalt of the joint structure of the dielectric-waveguide track of this invention.
[Drawing 2] It is the top view showing one principal plane of a dielectric layer in which other transmission lines are established.
[Drawing 3] It is X-X-ray sectional view of drawing 2 .

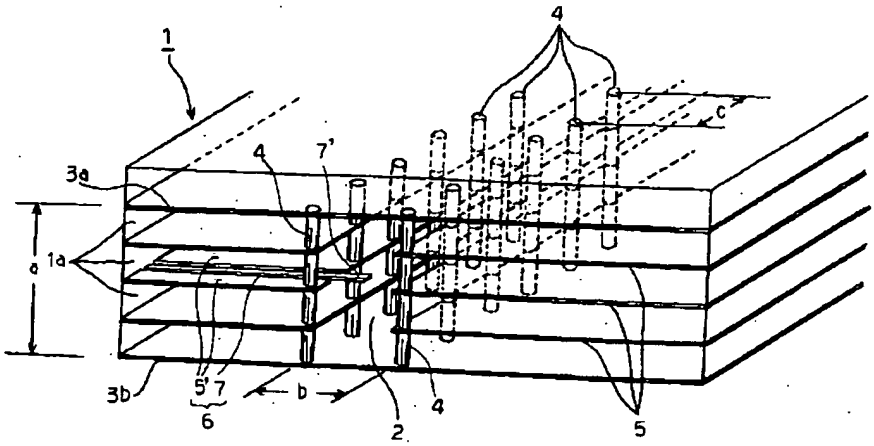
[Drawing 4] It is the outline perspective view showing other gestalten of the joint structure of the dielectric-waveguide track of this invention.
[Drawing 5] It is the top view showing other gestalten of the joint structure of the dielectric-waveguide track of this invention.
[Drawing 6] It is the top view showing other gestalten of the joint structure of the dielectric-waveguide track of this invention.
[Description of Notations]
1 ..... Dielectric substrate
2 ..... Dielectric-waveguide track
3a and 3b ..... Initiative body whorl of a pair
4 ..... Bahia hall
5 5' ..... Subconductor layer
6 and 6' -- the transmission line besides .....
7, 8, 9, 10 .... Line conductor
7', 8', 9', and 10 -- ' .. the end of a line conductor

[Translation done.]

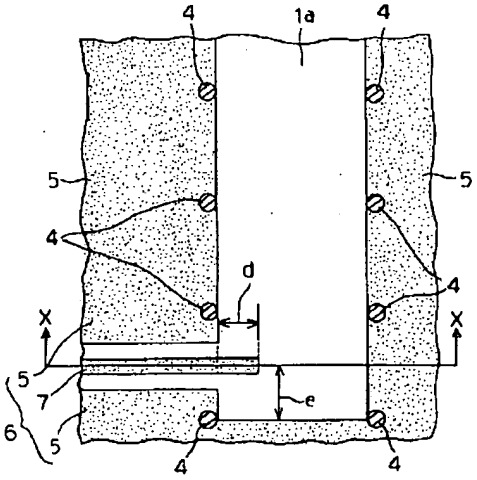
* NOTICES *

DRAWINGS

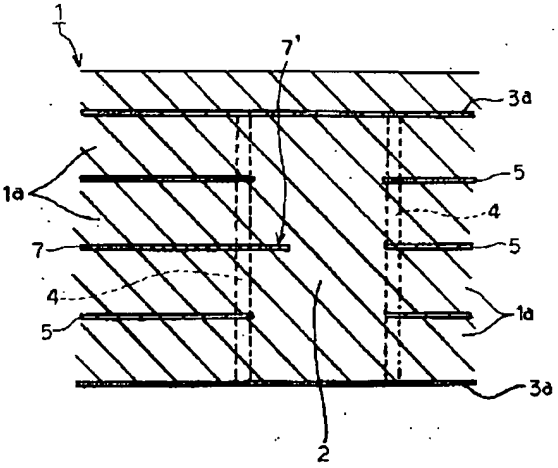
[Drawing 1]



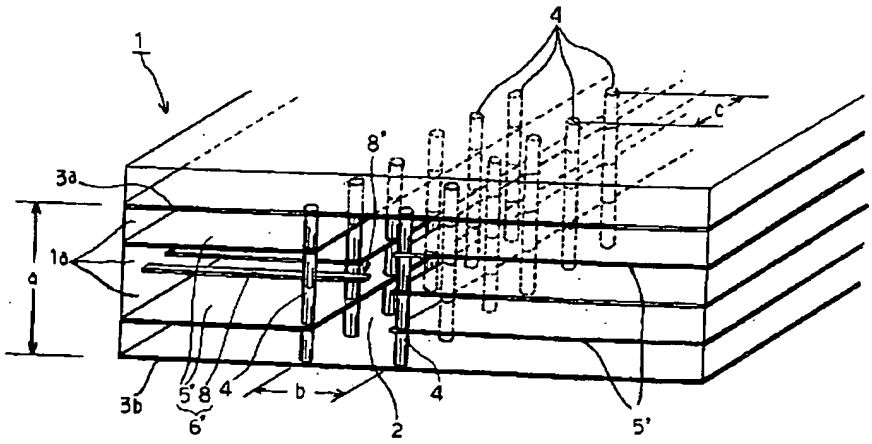
[Drawing 2]



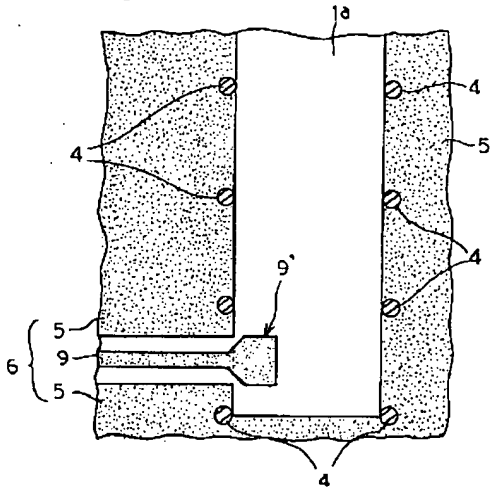
[Drawing 3]



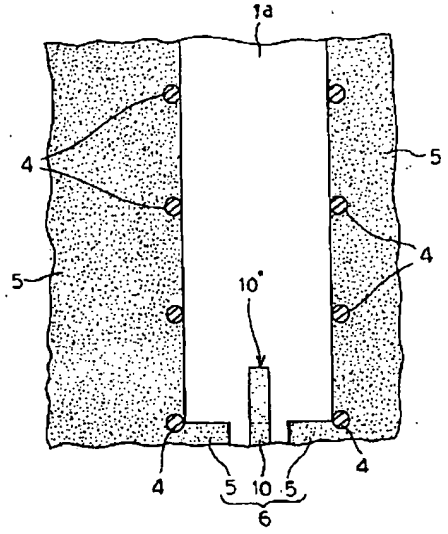
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]